

REMARKS

Claims 1-2 stand rejected under 35 U.S.C. §102(b) as being anticipated by Japanese Patent Application 01-239350 to Hiroaki.

Claims 3-4 stand rejected under 35 U.S.C. §102(b) as being anticipated by Japanese Patent Application 01-239350 to Hiroaki.

Claim 5 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Japanese Patent Application 01-239350 to Hiroaki, in view of Japanese Patent Application 11-063694 to Suzuki.

The present invention is a refrigerator in which two embodiments are described. The first embodiment is shown in Figure 1 and recited in claims 1, 2 and 5 and the second embodiment is shown in Figure 3 and recited in claims 3 and 4. The first embodiment consists of a compressor (21), a radiator (22), an evaporator (24). A temperature sensor (28) is placed on the line leading from the compressor (21) and measures temperature of the carbon dioxide refrigerant leaving the compressor (21). A control unit (29) is connected to the temperature sensor (28) and is also connected to a second throttle valve (27). As indicated on page 7, lines 9-18 the discharge gas temperature from the compressor (21) is measured by the temperature sensor (28) and when the temperature exceeds a preset temperature the control unit (29) opens the second throttle valve (27) which permits refrigerant in a supercritical state flowing out of the radiator (22) to be injected into the cylinder of the compressor (21).

The second embodiment of the present invention is shown in Figure 3 and described on pages 8-13 of the specification. The second embodiment of the present invention includes a compressor

(21), an outdoor heat exchanger (31) and an indoor heat exchanger (32). A temperature sensor (28) is placed on the line leading from the compressor (21) and measures temperature of the carbon dioxide refrigerant leaving the compressor (21). A control unit (29) is connected to the temperature sensor (28) and is also connected to a second throttle valve (27). As indicated on page 10, lines 21-31 the discharge gas temperature from the compressor (21) is measured by the temperature sensor (28) and when the temperature exceeds a preset temperature the control unit (29) opens the second throttle valve (27) which permits refrigerant in a supercritical state flowing out of the outdoor heat exchanger (31) to be injected into the cylinder of the compressor (21).

The point of injecting the refrigerant in the supercritical state is the main point of both embodiments of the present invention.

However, in Japanese Patent Application Laid-open No. 01-239350 to Hiroaki, the refrigerant which can be brought into a supercritical state is not charged into the above refrigeration cycle. In Japanese Patent Application Laid-open No. 11-063694 to Suzuki, the refrigerant which is used is carbon dioxide, but the bypass passage (9) of Suzuki's invention is provided on the downstream side of the first throttle valve (4). In addition, the bypass passage (9) is connected to the gas liquid separator (5), and the bypass passage (9) is constituted so that the gas refrigerant separated by the gas liquid separator (5) is flowed into the bypass passage (9).

The above differences are clearly shown in Fig. 2 of the present invention, Fig. 2 of Hiroaki patent (JP01-239350) and Fig. 3 of the Suzuki invention (JP11-63694).

By the injection in this invention, the refrigerant in the supercritical state is returned to the

compressor as shown with the wave lines of Fig. 2 (the lines with the arrow indicated as "Injection").

On the contrary, in the Hiroaki patent (JP01-239350), the refrigerant in the critical state is not originally used as shown in Fig. 2. As can be seen from Gc showing the injection (it is also explained in the specification that Gc of Fig. 2 corresponds to Gc of Fig. 1), the refrigerant in the liquid state is returned to the compressor after changing the state of the refrigerant from the gas-liquid two-phase state to the gas state.

In the Suzuki invention (JP11-63694), although the refrigerant is made to be in the supercritical state by the compressor as shown in Fig. 3, the refrigerant in the gas state, after the gas-liquid two phase state, is returned to the compressor as can be seen from the line shown from point C to point G in Fig. 3.

Thus, while the refrigerant in the supercritical state is returned to the compressor in this invention, the refrigerant in the gas state is returned to the compressor in the Hiroaki patent (JP01-239350) and the Suzuki invention (JP11-63694).

According to the present invention, since the refrigerant in the supercritical state is returned to the compressor, even if the amount of the refrigerant is small, it is possible to reduce the discharging temperature of the compressor, and the effect for not producing the problem of the liquid compression in the compressor can be given. Thus, this invention employs a mechanism that the refrigerant in the supercritical state is returned to the compressor, which was not anticipated in the prior art. Therefore, this invention cannot be made based on the prior art.

Therefore, independent claims 1 and 3 patentably distinguish over the prior art relied upon

U.S. Patent Application Serial No. 10/757,397

Reply to OA dated January 14, 2005

by reciting, as exemplified by claim 1,

“A refrigerator wherein at least a compressor, a radiator, a first throttle apparatus and an evaporator are connected to one another in an annular form to constitute a main circuit of a refrigeration cycle, a refrigerant which can be brought into a supercritical state by said radiator during operation is charged into said refrigeration cycle, an injection pipe branched off from a pipe between an outlet of said radiator and an inlet of said first throttle apparatus is connected to a cylinder of said compressor not via a receiver for separating gas and liquid from each other, and the refrigerant in the **supercritical state** is injected into said cylinder of said compressor.” (Emphasis Added)

Therefore, withdrawal of the rejections of claims 1-5 is respectfully requested.

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Conclusion

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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